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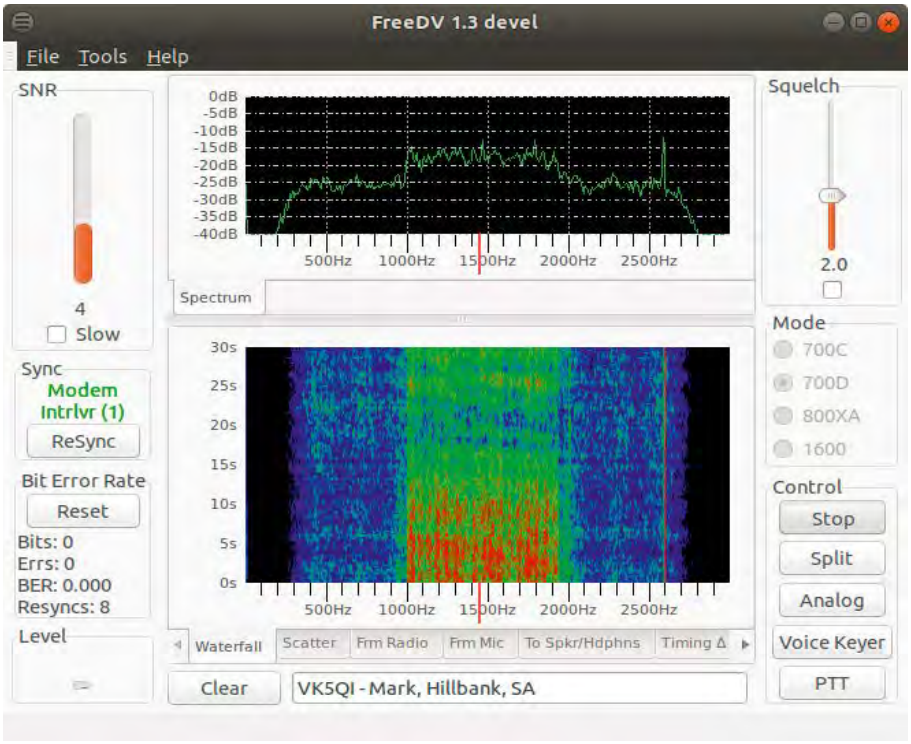
Digital Voice for HF

We have something a little different for this month's column. Eric Edwards GW8LJJ introduces FreeDV, the mode that is becoming the de facto solution for digital voice on the HF bands.

Many of you will be familiar with digital transmissions on the HF bands. These are usually RTTY, PSK31, WSPR and other data modes. This article is an introduction to digital voice. Again, there will be many that already know about voice communications using digital modes such as APCO, D-STAR, Fusion, DMR and NXDN. These have bandwidths that are too wide for the popular bands such as 80, 40 and 20m and are restricted to the upper VHF and UHF bands.



What's Different?

FreeDV is a digital voice system that is well suited for use on the popular HF bands and that includes 60m. As the name suggests, it is free! Also, any SSB transceiver can be used. There is no special radio or internet connection other than downloading the FreeDV software, which is simplicity itself and it can be downloaded onto any PC.

FreeDV

You can run FreeDV using a free GUI application for Windows, Linux and OSX that allows any SSB radio to be used for low bit rate digital voice. There are several reports of the new FreeDV 700D mode outperforming SSB at low signal-to-noise rations (SNRs). At high SNRs FreeDV sounds like FM, with no annoying analogue HF radio noise. Speech is compressed and then modulated onto a 1.00kHz wide signal, which is sent to the microphone input of an SSB radio. The signal is received by an SSB radio, then demodulated and decoded by FreeDV. FreeDV is unique in that it uses 100% Open Source Software, including the speech codec. No secrets, nothing proprietary! FreeDV represents a path for 21st century amateur radio where radio amateurs are free to experiment and innovate, rather than a future locked into a single manufacturer's closed technology.

FreeDV has been around for several years now but is starting to come of age, both in its development and usage. Modems are available, should you not want to use your PC and sound card but in this article I will focus on the software solution so that you can try FreeDV at no cost.

Should you want to know more, ther FreeDV website (below) is the place to find the answers – it has links, videos, history and much more.

http://freedv.org

What is Needed?

As an introduction to this mode it will prudent to start with a receive version. To receive FreeDV the software can be found on the FreeDV website, mentioned above. Scroll down the page until you reach the heading Download. The selection of software is available for different PCs and Windows has two versions, 32-bit and 64-bit. My setup is XP, which is 32-bit, and I also use Win7, which is also 32-bit. Others use Win10. You may have Win 10 and a new PC that has 64-bit so that will be the one you will need. Either way, once installed the software can run on a PC with no need for an internet connection. To receive the FreeDV transmissions it is only necessary to connect the output (headphones or loudspeaker) from your radio and tune for the digital voice signals. On the website there is a list of popular frequencies used for UK and other countries and I have included a list here as well (**Table 1**).

How Wide is the Signal?

The screenshot, **Fig. 1**, shows a comparison between two SSB signals (seen at the right) and a FreeDV signal (to the left of the SSB signals). The SSB signals are typically 3kHz wide whereas the FreeDV signal is just 1kHz wide! This screenshot was provided by **David Rowe VK5DGR**.

What about the Audio Quality?

Although this is digital voice and is

very narrow in comparison to the SSB transmission, it has an adequate dynamic audio range and the audio spectrum is typically as good as an average SSB signal but without the noise. The bands are getting a lot noisier and an SSB signal can be lost in the 'bacon and eggs' frying in the foreground. With FreeDV there is no noise. It is completely clear and the voice is punchy even when the received signal levels drop several 'S' points. Tests have been made with transmissions using SSB and FreeDV and showed that when a received SSB signal falls to, say, S5 it is unreadable whereas the same transmitter and power using FreeDV received S5 is no different to it being received at S9.

Setting up for Receiving FreeDV

To use FreeDV for receive only, and this will be a good starting point to get used to tuning in and listening to the digital transmissions, open the FreeDV software by clicking (or double-clicking) on the icon. Once opened, at the top left of the page you will see 'File Tools and Help'. Click on Tools and on Audio Config in the drop-down menu (first one in the list). A window will open in the centre of the main window and at the top of the upper window is labelled From Radio. Look for the soundcard installed in your PC and mouse-click. It will show the card in the aperture below, labelled Device. To verify that you have selected the correct one and with the radio output connected to the PC soundcard input (line in), press the Rec 2s button (and wait two seconds) seen on the right-hand side of the top window. If it is correct and the radio is producing an output, which can be noise or speech, there will be an indication of input from the radio as seen in **Fig. 2**. There is another aperture labelled Sample Rate and that will show 44100. Leave that as it is or change if it is different from a list in the drop-down menu.

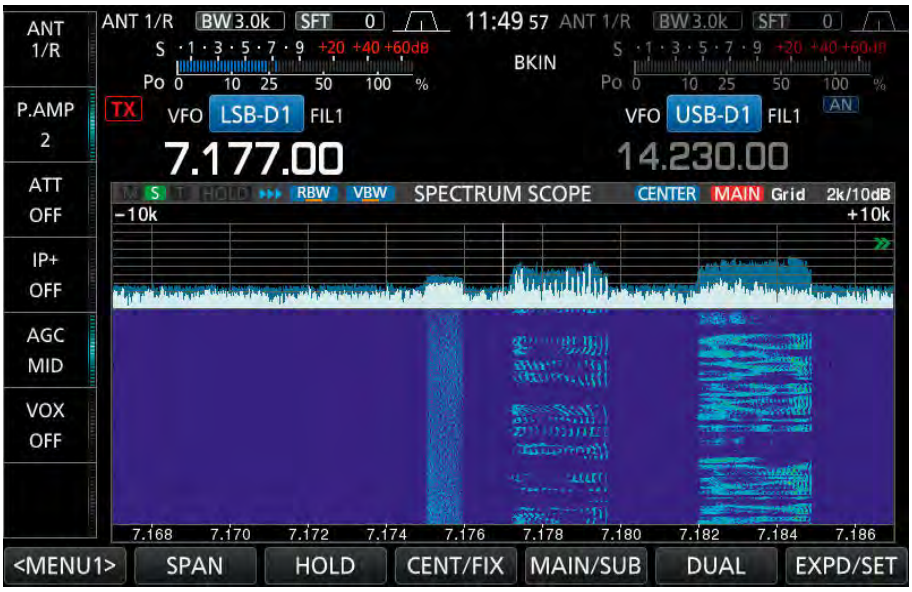


Fig. 1: A comparison between the spectra of FreeDV and SSB signals.

The bottom window is labelled To Speakers/Headphones. Under the heading Device is a list of items and the one you need to select is your soundcard. To verify that the correct one is selected, press the Play 2s button (and wait two seconds) and it will produce a note in your soundcard speaker.

Once that has been set up, click the 'X' at the top of the window inside the main one then press start and Analogue to hear your signals from the radio. The analogue button allows straight-through listening from the radio but when a digital signal is being received the Analogue button has to be depressed.

Your FreeDV has now been set up for receiving the digital voice signals and there is a choice of modes, 700C, 700D, 800XA and 1600. The popular ones are 700C and 700D. Some are using 1600 but most are experimenting with 700D and

Australia VK5
7.177MHz
Every Sunday 10AM Local
WIA Broadcast and call back

Australia VK3
14.150/14.153 MHz
Every day at 3 and 4pm AET
Casual QSOs

Netherlands
3.720 MHz in USB
Every Sunday 1000UTC
Net

UK
3.643MHz LSB
Sundays mornings at 09:00 Local
RSGB broadcast by Matt G6WPJ

UK
3.697 MHz LSB 700D
1600 Local
Casual QSOs

USA
14.236 MHz USB
Anytime
Casual QSOs

Table 1: Frequencies currently used for FreeDV.

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Get your favourite magazine your mobile, tablet or PC quickly & easily
pocketmags.com Discover Read Enjoy

Practical WIRELESS
Britain's Best Selling Amateur Radio Magazine
The ICOM IC-7610 reviewed
First UK review of this eagerly awaited HF SDR transceiver
Practical Way

Fig. 2: The software, showing audio being received from the radio.

this is the mode we are using in the UK on 3697kHz at about 1600 (local) daily. There are developments progressing to improve this system of digital voice operating and many of us are convinced this is the way forward in amateur radio and can be compared with the transition from AM to SSB in the 1950s and 1960s. As with those other newer modes, it is not a complete changeover and they work side by side as is evident with AM still having a large following. Band conditions are getting worse for noise and FreeDV is one answer to the problem.

History

In 2012 FreeDV was coded from scratch by **David Witten** (GUI, architecture) and **David Rowe** (Codec 2, modem implementation, integration). The FreeDV design and user interface is based on FDMDV, which was developed by **Francesco Lanza HB9TLK**. Francesco received advice on modem design from **Peter Martinez G3PLX**, who has also advised David on the FDMDV modem used in FreeDV. **Mel Whitten K0PFX** has contributed greatly to the design, testing and promotion of several Digital Voice systems, including FDMDV. This practical experience has led to the current design – a fast sync, no FEC, low latency system that gives an 'SSB' type feel for operators. Mel and a team of alpha testers (**Gerry N4DVR**; **Jim K3DCC**; **Rick WA6NUT**; **Tony K2MO**) provided feedback on usability and design of FreeDV. **Bruce Perens** has been a thought leader on Open Source, patent free voice codecs for amateur radio. He has inspired, promoted and encouraged the development of Codec 2 and FreeDV.

Credits

FreeDV is being maintained and extended by David Rowe VK5DGR. **Richard Shaw KF5OIM** maintains the Cmake build system, Windows and Fedora packaging. **Walter K5WH** is leading Windows testing in the USA. Debian packaging thanks to **A Maitland Bottoms AA4HS** and the Debian Hamradio Maintainers. **David Tiller K4DET** is kindly building OSX images for the project. As development continues, many others are becoming involved and their efforts are appreciated.

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